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Weight gain in freshman college students and perceived health

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ABSTRACT

Background. We determined body weight increase in first year Dutch college students. We had the objective to determine whether the awareness of the unhealthy lifestyle raised concerns and willingness to change habits.

Methods. Body weight, heartbeat, BMI, body fat percentages, and blood pressure values were collected from 1095 students. Comprehensive statistical analysis was performed on the data.

Results. The students had a mean weight gain of 1.1 kg and an average BMI gain of 0.35. Members of a student corps gained significantly more weight (1.6 ± 3.1 kg) than non-members (1.0 ± 2.5 kg), while students who are living independently gained an average of 0.5 kg more than students living with their parents ($p < 0.05$). Approximately 40% of the students changed their eating patterns and 30.7% of the students consumed more alcohol.

Conclusions. Students experienced hindrance in physical exercise and mental well-being. Students with a high BMI without irregular eating habits were willing to change their lifestyle. However, students who had irregular lifestyles exhibited the lowest willingness to change their eating behaviors and to lose weight. Our study provides insight into means by which adolescents at high risk for weight gain can be approached to improve experienced quality of life.

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Introduction

According to the World Health Organization, weight gain is one of the leading global health problems (Doak et al., 2012; Rolland-Cachera, 2011). One strategy to fight this epidemic health issue is to promote weight loss, however most people who successfully lose weight through lifestyle modifications regain the weight within several years (Lowe et al., 2006; Stice et al., 2012). Therefore, current research efforts are more focused on the prevention of weight gain rather than on the promotion of weight loss. Any prevention program is most successful when the program targets those at known risk, so it is important to identify predictors and susceptible periods of weight gain (Lowe et al., 2006).

The freshman period at university or college has been identified as a period of high risk for weight gain (Boujut and Bruchon-Schweitzer, 2009; Crombie et al., 2009; Crombie et al., 2012; Economos et al., 2008; Freedman, 2010; Gropper et al., 2012a, 2012b; Gropper et al., 2009; Gunes et al., 2012; Holm-Denoma et al., 2008; Jung et al., 2008;

Lloyd-Richardson et al., 2009; Mihalopoulos et al., 2008; Nies et al., 2012; Pliner and Saunders, 2008; Smith-Jackson and Reel, 2012; Thomas, 2006; Vella-Zarb and Elgar, 2009; Wansink et al., 2012; Yakusheva et al., 2011). Several studies performed in the United States have shown that students attending their first year of university or college gain significantly more weight than age-matched individuals who do not attend university or college (Anderson et al., 2003b; Butler et al., 2004). Two papers confirm that weight gain also occurs in students in Europe (Deliens et al., 2013; Finlayson et al., 2012) but the causes for this seem to be different from that in the United States. This period has been called the “freshman 15” because of the myth that the typical weight gain in the first year of university or college is fifteen pounds. This 15 lbs is a real myth as in most cases it is less but still consistently present (Boujut and Bruchon-Schweitzer, 2009; Crombie et al., 2009; Crombie et al., 2012; Economos et al., 2008; Freedman, 2010; Gropper et al., 2012a, 2012b; Gropper et al., 2009; Gunes et al., 2012; Holm-Denoma et al., 2008; Jung et al., 2008; Lloyd-Richardson et al., 2009; Mihalopoulos et al., 2008; Nies et al., 2012; Pliner and Saunders, 2008; Smith-Jackson and Reel, 2012; Thomas, 2006; Vella-Zarb and Elgar, 2009; Wansink et al., 2012; Yakusheva et al., 2011). During the freshman time period, many social forces act on students to change their feeding, drinking, and sporting behavior (Graham and Jones, 2002; Lowry et al., 2000; Rozin et al., 2003), which can have

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long-lasting effects on weight and health (Hoffman et al., 2006). Weight gain is most pronounced in the first semester of the first year at university. The published studies are consistent in that they all indicate that there is a period of weight gain during the freshman year, although the reported weight gain varies considerably from 1.9 kg (Levitsky et al., 2004) to 0.9 kg (Hovell et al., 1985). Another recent report demonstrated that this weight gain is substantial and permanent, and thus can present serious life-long issues (Gropper et al., 2012a, 2012b).

The majority of studies on freshman weight gain have been carried out in the United States (USA). There are, however, substantial lifestyle differences between college students in most European countries (Deliens et al., 2013; Finlayson et al., 2012). In the USA most students move to the campus of the university, where they typically have “all-you-can-eat” meal plans (Levitsky et al., 2006; Levitsky et al., 2004) and lack parental supervision. In Europe there are rarely campuses connected to universities. College students have a choice to stay with their parents or to live in student houses. This allowed us to study weight gain in freshmen who live in different environments, e.g., in their parents' home, with minor lifestyle changes, or in a student home, with substantial lifestyle changes. Moreover, in the Netherlands college students can become a member of a student corps, for which they make a commitment to be present at many social events. In this study we determined body weight increases in first year Dutch college students as the consequence of a changed lifestyle. We determined which life style changes contribute to the weight gain. We also studied whether the awareness of the unhealthy lifestyle raised concerns and willingness to change habits.

Materials and methods

Ethics statement

This study was the result of an annual practical training for life sciences students. Students were taught how to measure parameters such as measuring weight, heartbeat, BMI, body fat percentages, and blood pressure. After the practical assignment, they received a series of lectures explaining the phenomenon of freshmen weight gain and the physiology of obesity. We discussed our approach with the Institutional Ethical Commission. According to the Medical Ethical Committee of the University Medical Center Groningen (UMCG), we did not need medical ethical approval for the study, as the procedures did not use human samples and the study was the direct result of an educational training program in the life sciences. Students were guaranteed that the results would be processed anonymously. The procedure was approved by the Medical Ethical Committee of the UMCG, and conducted according to the principles expressed in the Declaration of Helsinki.

Population

The study was based on data collected from 2006 until 2009 by the University Hospital and the University of Groningen. The students who participated in this study were all freshmen (18–20 years old) studying life sciences at the University of Groningen.

Data was collected at two time-points: (1) At the beginning of September, during the first week of arrival at the university ($T = 1$), and at the end of December, when the first semester finished ($T = 2$). At both occasions bodyweight (in underwear) and height were measured and BMI (weight/height^2) was calculated. At each time-point, the students also completed a questionnaire regarding their health status and perception thereof. The questionnaire included 134 questions on gender, age, living arrangements (with parents or in a student house), membership of student corps, eating habits, health perception. The questionnaires are available upon request (versions available from 2006 and 2007–2009). Responses to the questionnaire

were analyzed using advanced statistical techniques. In total 1238 students were originally enrolled in the study, however some were excluded due to issues such as illness or not failure to answer essential questions on the questionnaire. The final analysis included data from 1095 students at both time-points.

Data analysis

Analysis of weight gain. We analyzed the data longitudinally, as students provided data at two time-points. In order to explain the change in body weight, we use the fixed effects model. The individual characteristics analyzed were: gender, housing situation, and student corps membership. The lifestyle items analyzed were: being a vegetarian, number of meals per day, skipping breakfast or lunch, number of snacks per day, and number of glasses of alcohol per week. The model was corrected for being on a specific diet (for medical and/or ethnical reasons), frequency of eating at certain places or situations (e.g. in restaurants or in groups) or certain foods (e.g. take-out food), none of which had a significant effect on body weight changes.

As the Netherlands experiences strong seasonal fluctuations in weather, we also evaluated whether any observed weight changes could be explained by seasonal weight fluctuations. A study by Visscher and Seidell (2004) showed that body weight for both men and women was on average 0.2 kg lower at the beginning of autumn (September) than during winter (end of December), and the weight difference between summer and winter was even higher (0.7 kg). We used the most extreme seasonal difference (0.7 kg) as the criterion for actual weight gain and calculated the proportion of students meeting this criterion. In order to be able to compare our findings with the study by Anderson et al. (2003a), we also used a broader definition for weight gain of 2.3 kg (5 lbs).

Analysis of students' self-perception of health. This analysis consisted of an exploratory component and an explanatory component (Hausman, 1978; Hausman and Taylor, 1981). In the exploratory stage, all questionnaire responses (Table 1) were used to extract useful measures (factors) of the perception of health. The questionnaire contained many rating scale responses about the perception of health, habits, eating patterns, physical condition, and the willingness to change these factors. We performed a latent factor analysis on rescaled values of the responses. For rescaling, we used the principal factor method because of the non-normality of the variables. Factors were extracted based on Kaiser's criterion (the scree plot), and a preliminary correlation analysis and with rotation of the factor loadings by the Oblimin algorithm to facilitate interpretation.

In the explanatory stage we used the extracted factors as outcomes in effects regression models with the predictors' year, gender, blood pressure, BMI, eating habits, exercise patterns, smoking, and drinking habits. We made a uniform selection of predictors based on their relevance, parsimony of the model and completeness of data.

The variables describing health perception and willingness to change are presented in Table 1. The factor analysis of the questionnaire responses led to the identification of four factors of health perception by the students:

1. The extent to which the health status hindered the student in normal everyday life (variables included: Feellessdaily, Feellessachiev, Feelrestrdaily, Feelstrsstudy, see Table 1 for full definitions).
2. Worry about current health and resistance and the expectation of their developments (variables included: Feelgener, Feelyrago, Feelrestrheavy, Felloftenill, Feelhealthy, Feelexpworse, Feellexcellent, see Table 1 for full definitions).
3. The extent to which physical condition hindered the student in physical endurance (variables included: Feelstrheavy, Feelstrmod, Feelrestr 1 km, Feelrestr 500 m and Feelrestr100 m, see Table 1 for full definitions).

Table 1

Factors describing health perception and willingness to change. The abbreviations are written out under description.

Perception of and willingness to change eating and drinking habits			
Variable	Description	Coding	N
Feeleatmuch	Does Student feel (s)he eats too much?	1 = yes	1985
Feeleatlittle	Does Student feel (s)he eats too little	1 = yes	1985
Feeleatwrong	Does Student feel (s)he eats the wrong things?	1 = yes	1985
Feeleatright	Does Student feel eating habits are exactly right?	1 = yes	1985
Changeeatless	Does Student want to eat less to lose weight?	1 = yes	1993
Changeeatlessalc	Does Student want to drink less alcohol?	1 = yes	1993
Changeeathealthy	Does Student want to eat healthier?	1 = yes	1993
Changequitsmk	Does Student want to quit smoking?	1 = yes	1993
Changemoreex	Does Student want to exercise more?	1 = yes	1993
Changenothing	Does Student want to change none of these?	1 = yes	1993
Classifications of health perception			
Variable	Description	Coding	N
Feelgener	General feeling of his/her health and resistance 3 = good, 4 = poor, 5 = bad	1 = perfect, 2 = very good,	1985
Feelyrago	Feeling of health compared to a year ago	1 = much better, 2 = better, 3 = similar, 4 = worse, 5 = much worse	1989
Feelrestrheavy	Does Student feel restricted at heavy exercise?	1 = no, 2 = a little, 3 = much	1983
Feelrestrmod	Does Student feel restricted at moderate exercise?	1 = no, 2 = a little, 3 = much	1966
Feelrestr1km	Does Student feel restr. at walking more than 1 km?	1 = no, 2 = a little, 3 = much	1986
Feelrestr500m	Does Student feel restr. at walking more than 500 m?	1 = no, 2 = a little, 3 = much	1979
Feelrestr100m	Does Student feel restr. at walking more than 100 m?	1 = no, 2 = a little, 3 = much	1980
Feellessdaily	Student had less time for daily act. in past 4 weeks due to health?	1 = yes	1977
Feellessachiev	Student achieved less in past 4 weeks due to health?	1 = yes	1979
Feelrestrdaily	Did Student feel restr. in daily act. in past 4 weeks due to health?	1 = yes	1977
Feelrestrstudy	Did Student feel restr. in studying in past 4 weeks due to health?	1 = yes	1976
Feeloftenill	Student feels to be ill more often than others?	1 = surely not, 2 = not really, 3 = don't know, 4 = a bit, 5 = surely	1990
Feelhealthy	Student feels as healthy as others?	1 = surely, 2 = a bit, 3 = don't know, 4 = not really, 5 = surely not	1988
Feelexpworse	Student expects health to worsen in near future?	1 = surely not, 2 = not really, 3 = don't know, 4 = a bit, 5 = surely	1988
Feelexcellent	Student feels health is excellent?	1 = surely, 2 = a bit, 3 = don't know, 4 = not really, 5 = surely not	1991

4. The extent to which the student was willing to lose weight and change eating habits (variables included: Feeleatmuch, Feeleatlittle, Changeeatless, Changeeathealthy, changemoreex, see Table 1 for full definitions).

Results

Table 2 shows the characteristics of the population of the freshman students enrolled in the study. There were slightly more females (57.7%) than males (42.3%). The transition frequency for membership in a student corps or living under parental supervision was low (Table 2) and did not influence the analysis. In the first semester, the students underwent a mean weight gain of 1.1 kg and a BMI gain of 0.35 (both statistically significant, $p < 0.05$).

Not all students experienced weight gain. Overall, 68.7% of the students gained weight, with an average increase of 2.3 ± 1.8 kg, and 27.7% of the students lost weight in the same period (Table 3). More than 57% of the participants met the criterion of gaining more than the maximal seasonal weight change of 0.7 kg (Visscher and Seidell, 2004). Using the criterion of 2.3 kg (Anderson et al., 2003a), 26.6% of the students still gained weight, while most students (67.4%) did not change weight.

Individual characteristics, lifestyle changes and weight gain in freshmen

Gender had no effect on weight gain in the first semester of the freshman year (male weight gain: 1.2 ± 2.8 kg; female weight gain

1.0 ± 2.4 kg). Students who lived without their parents during this time period gained 0.5 kg more than students who remained under parental supervision (1.3 ± 2.6 kg versus 0.8 ± 2.6 kg respectively; $p < 0.05$). Students who were members of a student corps gained significantly more weight (1.6 ± 3.1 kg) than non-members (1.0 ± 2.5 kg; $p < 0.05$) during the first semester of freshman year.

Table 2

Characteristics of the student population in September and December.

	September (N = 1095)	December (N = 1095)	Transition frequencies ^a
<i>Gender</i>			
Male	463 (42.3%)	–	–
Female	632 (57.7%)	–	–
<i>Corps membership</i>			
Member	158 (14.5%)	150 (13.8%)	23 (2.1%)
Non-member	931 (85.5%)	939 (86.2%)	15 (1.4%)
<i>Housing</i>			
With parents	466 (42.8%)	346 (31.7%)	133 (12.2%)
Without parents	624 (57.2%)	744 (68.3%)	13 (1.2%)
<i>Measurements</i>			
Mean weight (kg) (SD)	67.5 (10.8)	68.6 (11.0)*	–
Mean height (cm) (SD)	176.8 (9.1)	–	–
Mean BMI* (SD)	21.6 (2.8)	21.9 (2.8)*	–

^a Percentage of students that changed during the semester.

* $p < 0.05$ for change versus September (Mann–Whitney–U test).

Table 3

Overall weight change (gain, loss, or unchanged) during the first semester of freshman year, and weight change by narrow and broad criterion for seasonal weight change.

	Number	Percentage	Mean (SD)
<i>Overall</i>			
Weight gain	747	68.7%	2.3 (1.8)
Weight loss	301	27.7%	−1.7 (2.2)
No change	39	3.6%	–
Total	1087	100%	1.1 (2.6)
<i>Narrow definition (0.7 kg)</i>			
Weight gain > 0.7 kg	623	57.3%	2.7 (1.8)
Weight loss > 0.7 kg	204	18.8%	−2.3 (2.4)
Change less than 0.7 kg	260	23.9%	0.05 (0.4)
<i>Broad definition (2.3 kg)</i>			
Weight gain > 2.3 kg	289	26.6%	4.0 (1.8)
Weight loss > 2.3 kg	65	6.0%	−4.4 (3.4)
Change less than 2.3 kg	733	67.4%	0.44 (1.2)

Table 4 shows the results of multivariable longitudinal analysis of the influence of changes of determinants on weight change. Among the lifestyle characteristics, only changes in housing situation and alcohol consumption were significant determinants of the change in bodyweight in these students. Becoming a member of a student corps per se was not a determinant of the increase in bodyweight in this model, which was adjusted for the frequency of eating at a restaurant or in a group, as well as for the frequency of eating snacks of different types.

We also studied the changes of eating habits that occurred from the beginning of September to the end of December. Overall, 53.1% of the students changed their intake of alcoholic beverages during this time period; 30.7% of the students increased their alcohol intake, while 22.4% of the students decreased their alcohol intake. Although many students, about 40%, changed their eating patterns (as measured with irregular eating pattern, numbers of meals per day, number of snacks per day, eating in restaurant, eating with group, take-away food, fast food, fresh food, prepared food) between September and December, the increase or decrease in the percentage of students were similar or small for almost all variables measured.

We also considered that reduction of exercise may contribute to weight gain, but there were no differences in participation in exercise or sports between the two-time points (data not shown). All students exercised at least 30 min per day and performed light household work an average of 3.5 h per week. Most students performed heavy exercise an average of 5 h per week.

Quantitative analysis of perceived health

Next we studied whether the observed weight gain was also perceived as unhealthy and undesired by the students. Twelve percent

Table 4

Multivariable analysis of the influences of changes of determinants on body weight change.

	Coefficient (SE)
Student corps	−0.015 (0.416)
Housing	0.672 (0.267)*
Vegetarian	0.001 (0.580)
Meals per day	−0.072 (0.094)
Skip breakfast	0.100 (0.218)
Skip lunch	0.261 (0.192)
Snacks per day	0.018 (0.136)
Alcohol	0.174 (0.070)*

Adjusted for types of snacks (candy, fruit and wheat), frequency of eating in a restaurant or in a group, and frequency of consumption of various types of food (take-out food, fast food, prepared food and fresh food).

* $p < 0.05$ (Fixed effects model).

of the students felt that they had poor or bad health, and 30% of the students felt less healthy than one year before. Males felt slightly better about their health than women. Twenty-three percent of the students felt seriously restricted during strenuous physical exercise, whereas only 5% felt restricted during light exercise. Ten percent of the respondents reported to feel that his/her own health is bad or will become worse in the next year. About 50% of the students with normal weight (BMI 18.5–25) were concerned about their eating pattern and were willing to change this. The underweight students (BMI < 18.5) were slightly less concerned (about 32%), but still willing to change their eating habits. The overweight students (BMI > 25), however, were slightly more concerned (56%) and more willing to change their eating habits. Interestingly, 10% of the underweight students still felt that they over-ate (data not shown).

Perception of health and willingness to change habits

Table 5 shows the results for the analysis of the health perception factors. Positive values indicate a worsening effect, while negative values indicate an improving effect. Statistically significant differences are indicated in Table 5.

Using a random effects model, we observed a gender effect for factor 1 in that women experienced more hindrance from their health status than men. We found that a number of factors contributed to the worsening of hindrance, and these factors had relatively large positive

Table 5

Health perception factors and variables that were of influence. 1. The extent to which the health status hindered the student in normal everyday life (everyday hinder); 2. Worry about current health and resistance and the expectation of their developments (Health concerns); 3. The extent to which the physical condition hindered the student in physical endurance (exercise hinder); 4. The extent to which the student was willing to lose weight and change eating habits. (Willing change eat pattern).

	Everyday hinder (Random eff.)	Health concerns (Fixed eff.)	Exercise hinder (Random eff.)	Willing change eat pattern (Random eff.)
Gender	.1262 (.0599)**		.0711 (.0646)	.1906 (.0632)***
Stud corps	.2626 (.0942)***	−.0410 (.1495)	.0969 (.0839)	−.0255 (.0731)
Without parents	.0651 (.0556)	.0123 (.0952)	−.0263 (.0602)	.0103 (.0557)
BMI	−.0175 (.0220)	.0531 (.0555)	.0270 (.0177)	.1040 (.0219)***
Quit smoking	.1486 (.1706)	.5966 (.2604)**	.1011 (.1586)	−.0568 (.1555)
Regular smoker	.1272 (.1159)	.2562 (.2261)	.4087 (.2220)	.0036 (.1191)
Total sports	.0039 (0.005)	.0156 (0.009)	.0118 (0.0055)	−.0045 (0.0067)
Vegetarian	.1601 (.1607)	.8972 (.3770)**	.2743 (.2273)	.0616 (.1007)
Heartbeat ratio	.4043 (.3610)	.3062 (.3946)	.7902 (.3347)**	.2058 (.2837)
Diet	.1084 (.0911)	−.0707 (.1002)	.0551 (.0626)	.2676 (.0723)***
Nr. of snacks	.1120 (.0388)***	.0769 (.0494)	.0671 (.0438)	−.0908 (.0379)**
Skip breakfast	.0252 (.1000)	−.0090 (.0934)	.00007 (.0721)	−.3254 (.0761)***
Bad dinner choice	.0626 (.0276)**	.0444 (.0372)	.0583 (.0254)**	−.0731 (.0243)***
Alcohol cons.	−.0385 (.0143)***	.0734 (.0273)***	−.0253 (.0138)*	.0125 (.0139)

Standard errors in parentheses, (*)(**)(***) = significant at the 95/99/99.9% level.

Heartbeat ratio: the ratio of measured beats per minute of the heart at rest to the maximum allowed heart rate based on the age of the respondent.

Abbreviation: Stud corps: member of student corps; without parents: living apart from parents; BMI, body mass index; quit smoking: quit smoking during study period; regular smoker: smoking regularly; total sports: all sports and exercise together; nr. of snacks, number of snacks consumed per day; skip breakfast, skipping breakfast; bad dinner choice: bad eating habits; alcohol cons: alcohol consumption.

coefficients and were all associated with an unhealthy lifestyle. A clear measure for this unhealthy lifestyle was an increased frequency of consumption of snacks and unhealthy dinner alternatives. However, being a member of a student corps was also associated with a lower experienced well-being. This may be related to the fact that corps students spend much time at the corps residence and may have a disturbed rhythm with experienced hindrance in physical tasks as a consequence. Alcohol consumption was an improving factor.

Factor 2, worries about current health, required a fixed effects model. We observed the consequences of a reverse causality problem with quitting smoking. Students quit smoking because of health worries, not vice versa. Worsening effects were being a vegetarian and alcohol consumption.

Factor 3, hindrance in physical condition, was also analyzed using a random effects model. Unfavorable dinner alternatives and heartbeat ratio contributed to physical problems. We found total sports participation to improve physical condition, but surprisingly, we also found alcohol consumption to be associated with improved physical condition. However, in the model for this factor, alcohol consumption was associated with an active lifestyle in which one is also more concerned about physical condition.

For factor 4, willingness to change eating habits, we used a random effects model. Willingness to change eating patterns was higher among women than among men. BMI also had a significant effect on the willingness to change eating patterns. Students with a high BMI were more willing to change their eating patterns. In addition, the diet affected the willingness to change the eating pattern. Our model shows that students are less willing to change a more irregular student lifestyle (e.g. eating more snacks, choosing bad dinner alternatives, drinking alcohol).

Discussion

Our study differed from that of previous studies in that we were interested not only in weight gain in the freshman group as a whole, but we also studied the differences in subgroups of students and the causes of weight gain. We applied comprehensive biostatistical methods, which allowed us to identify the groups at highest risk. We found that significant risk factors for weight gain during the freshman year were living independently and alcohol consumption. Although, being a member of a student corps was not significant in the multivariable analysis, we found that this group gained significantly more weight and consumed more alcohol than students that were not a member of a student corps, suggesting that still this group is at risk for high weight gain during the freshman year. This knowledge facilitates the design of cost effective strategies to prevent weight gain in these groups.

We made some unexpected observations that, to the best of our knowledge, have not been previously addressed. We found a rather strong difference between individual students, in that one group of students gained weight, while another large group of students lost weight. This brought the mean weight gain down. By focusing on the group of students that gained weight, we found that in the Dutch population the freshman weight gain was 2.3 kg in 3 months, which we consider to be substantial.

The 2.3 kg weight gain is higher than would be expected as a result of seasonal fluctuations. We believe that this seasonal correction is an important step in the data analysis of periodic weight gain that has not been addressed in many previous studies, which were unclear regarding the time of year. As seasonal variations may account for up to up to 0.7 kg, many freshman gains around 0.7 kg may be falsely classified as life-style induced rather than normal seasonal fluctuation. The distribution we found after the correction for seasonal fluctuation was similar to the results of [Anderson et al. \(2003a\)](#) and [Anderson et al. \(2003b\)](#).

A significant factor that contributes to weight gain is increased alcohol consumption. This finding was expected, especially in the

group of students who joined a student corps. Other factors that have been reported as causal for weight gain, such as more fast food, more take-out food, and less fresh food ([Graham and Jones, 2002](#); [Lowry et al., 2000](#); [Rozin et al., 2003](#)), could not be confirmed in the Dutch freshman population. The category that took less take away food was equal to the group that took more. We found, however, many significant changes in the feeding behavior, which were heterogenic and rather personal. In that respect the Dutch population of freshman students seems to differ from the students in the USA. An increase in fast food consumption is more commonly seen in the American freshman student population, but is not always a predominant factor in the Dutch population. Similarly, in previous studies a decrease in physical exercise was considered to be a factor in freshman weight gain for American students ([Graham and Jones, 2002](#); [Lowry et al., 2000](#); [Rozin et al., 2003](#)), and this could not be confirmed in for the Dutch freshman student population.

Interestingly, we found that about 50% of the students were concerned about their eating habits. This may indicate that the freshmen students in the Netherlands are a group of people who, with adequate education and instruction, could be persuaded to eat healthier. Another positive finding is that students with a high BMI appear slightly more concerned about their eating habits than students in the normal weight group and are more willing to change their eating pattern. This result is confirmed by the factor analysis in which the BMI has a significant effect on the extent to which students are willing to lose weight and to change their eating habits. Targeting the overweight group may therefore be very cost-effective. On the other hand, a surprising finding was that 10% of the students who are underweight, still think that they eat too much. Although our study was designed to investigate weight gain, we feel that this group of underweight students should receive considerable attention, as they are on high risk of malnutrition associated disorders.

To analyze health perception and willingness to change eating patterns, we used advanced statistical methods, in which 25 questions related to this subject were clustered into 4 factors mentioned in the results section. Two of the factors (factor 1 and 4) correlated strongly with gender and suggest that female students are more hindered by their health status than male students and are also more willing to change their eating pattern than males. Therefore, in educating students about their lifestyle, males should be convinced and educated more about their unhealthy habits than females.

We observed a larger effect on the extent to which health status hinders everyday life from membership in a student corps. This effect of health status on hindrance to everyday life also correlated with snack consumption, bad dinner alternatives and alcohol consumption, suggesting that an irregular lifestyle is associated with being a member of a student society and may negatively affect student achievements. As being a member of a student society may be a risk for weight gain, as shown in the univariate analysis, this group may deserve considerable attention. That being member of a student society was not a significant factor in our multivariate analysis, may be due to the fact that this multivariate analysis was corrected for frequency of eating at a restaurant or in a group, as well as for the frequency of eating snacks of different types. This suggests that such habits may be different (i.e. more common) in members of student societies. This group of members of student societies can possibly be targeted in the beginning of September with education about eating habits for prevention of freshman weight gain. However, this may require a special approach, as our model also shows that students are less willing to change a more irregular student lifestyle (e.g. eating more snacks, choosing bad dinner alternatives, drinking alcohol). These observations prompted us to perform a pilot experiment (data not shown) by supplying students with a scale and asking them to measure and record their body weight on a weekly basis. This pilot group did not gain or lose weight. Thus, making the students aware of their weight may be an effective method to prevent weight gain in this group.

Unfortunately our study also has some limitations. Our study is mainly an observational study, since many interventions such as food and drink restriction as well as behavior therapy are not allowed within such a study in the Netherlands. Moreover, invasive procedures such as blood sampling are also not allowed for educational purposes which, prevented measurements of eg lipid levels. Also scanning of adipose tissue accumulation is not allowed and would have strengthened our argumentation of drawback in health.

In summary, as in the USA, freshman college students in the Netherlands gain weight during the first semester. This weight gain was significant in students that had moved out of their parents' home, but was also observed in students who joined a student corps. This appeared to be mainly due to greater alcohol consumption and an irregular feeding pattern. Since 50% of the students were concerned about their health and eating patterns, freshmen in the Netherlands may be persuaded to eat healthier. This however, may be a challenge, as students with an unhealthier lifestyle were less willing to change their behaviors. Moreover, males and females may require separate gender-specific approaches.

Conflicts of interest

Nothing to report.

Author contributions

PdV, MMF performed the study, participated in its design. CH, HG, MN, DP performed the statistical analysis. PdV, MMF, CH, HG, MN, DP helped drafting the manuscript. We read and approved the final manuscript.

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